

Turbo-Electrification from Swoboda Takes a Load Off Combustion Engines

The Cross Charger helps to meet challenging Euro 7 exhaust emission targets and increases driving enjoyment

Wiggensbach/Schorndorf, March 21, 2022. The Swoboda electric exhaust gas turbocharger actuator, the 'Cross Charger,' offers vehicle manufacturers the solution to the increased demands for reduced emissions and consumption of combustion engines. The Cross Charger offers gasoline, diesel and hybrid drives that are up to 10% more economical with fewer emissions, no turbo lag and is cost efficient. Developed by Swoboda in collaboration with technology partners, the innovation offers three unique electric turbocharger advantages: the electric media gap motor, energy recovery functionality and the modular add-on design for easy installation. A premium OEM is already testing the Cross Charger for series production. The system is also ideal for hydrogen drive systems in cars and commercial vehicles.

While many automakers are shifting to fully electric drivetrains, from a global standpoint, the combustion engine is far from being obsolete: According to a recent study¹, the combustion engine will still be the main drive system for half of all new cars produced in 2030 – approximately 50 million vehicles, including hybrids. The engine remains just as indispensable for commercial vehicles. Nevertheless, the combustion engine needs to improve significantly.

"Our Cross Charger, a new electrification solution for exhaust gas turbochargers, enables gasoline and diesel engines to fulfill the enormous requirements that they face," says Christian Göser, head of sales and engineering, Swoboda.

Electrification: Emotions Instead of Emissions

The innovative design makes driving more enjoyable by temporarily increasing torque and power by up to 80%, eliminating turbo lag and improving acceleration from a standstill by up to 55%². With the electric turbocharger upgrade, a test car reaches 55 km/h in 2.5 seconds – in contrast, a conventionally charged vehicle reaches a speed of just 25 km/h. Additionally, the Cross Charger can significantly reduce consumption and emissions. In tests, a two-liter diesel engine consumed up to 10% less fuel and emitted 40% less nitrogen oxide (NO_x). With the Euro 7 standard set to come into force in 2025, nitrogen oxide emissions must decrease considerably together with a significantly shorter engine warm-up time.

"Swoboda is making it easier for vehicle manufacturers to achieve these Euro 7 targets. The Cross Charger should benefit as many vehicles and applications as possible, from downsized Otto engines in a plug-in hybrid to large-volume diesel engines in commercial vehicles. With

¹ IHS Markit Light Vehicle Alternative Propulsion Forecast Oct. 2021

² 2.0-L GDI four-cylinder turbo engine in a sporty compact car

this in mind, the key development objectives were that the system should be easy to install and cost comparatively little," says Göser. "Swoboda achieved this with numerous construction and design innovations that set the Cross Charger apart from previous electrified series turbochargers on the market."

No Need to Remove an Existing Exhaust Gas Turbocharger

Only with the Swoboda innovation is it possible to retrospectively electrify an existing turbocharger. The actuator is then installed as a custom-fit, add-on solution in front of the compressor wheel of the turbocharger. As a result, it does not need to come wrapped up from the outset as an integrated component of a new, expensive charging system.

"Up to 90% of components of an existing series charger can be retained with our solution. Nevertheless, it hardly requires any additional installation space," says Holger Gödeke, managing partner, G+L innotec, Swoboda partner which developed the basic principles of the Cross Charger technology.

This add-on principle for turbochargers is also ideal for achieving different power options based on a charged basic unit, the Cross Charger then enhances the performance of top engines. The unit can also switch to regenerative mode and recover energy, converting unnecessary exhaust gas energy into charging current for the battery. Depending on the installation space, the control electronics developed by Swoboda can be installed as an integrated solution directly on the turbocharger or as a separate box.

A Media Gap Exposes the Motor to Less Thermal Stress

The new installation location in front of the compressor wheel also has major advantages for the electric motor. In this position, the motor is exposed to a maximum of 120 degrees Celsius. This eliminates the need for complex cooling systems and the risk of the heat-sensitive rotor being demagnetized. Due to the design, the rotating mass of the turbocharger is increased only insignificantly (< 5%) by the media gap motor used. This is fundamentally different to conventional designs, whereby the electric motor is located at the bearing between the exhaust gas turbine and air compressor – one of the turbocharger components most exposed to thermal (up to 350 degrees Celsius) and mechanical (up to 300,000 revolutions per minute) stresses. Furthermore, this conventional approach increases the moment of inertia by over 20%, significantly impairing the response behavior of the turbocharger.

The electric motor of the Cross Charger can only sit in the more advantageous position, in front of the compressor wheel, because it was constructed with a unique design. The media gap motor leaves enough space between the rotor and stator for all the intake air to flow through it. This also has the positive secondary effect of cooling the motor. The increased distance between the main components does not affect electromotive efficiency – at 95%, this is at the same high level of conventional products from competitors.

Clean Power Source Attracts Lots of Interest

The Cross Charger shares a basic operating principle with other electric turbochargers. In low load ranges, i.e., at low speed and therefore low exhaust gas pressure, a several-kilowatt electric motor revs up the intake turbine at lightning speed, when the gas pedal is pressed the

desired boost comes immediately and from the bottom up. This gives combustion engines higher maximum torque, a current reference turbocharged engine² increased from 380 Nm to 475 Nm, thanks to the Cross Charger alone. It also allows engines to operate for longer in the optimum efficiency range, which reduces consumption. In particular, with the Cross Charger, the exhaust gas recirculation system (EGR) becomes more effective and aftertreatment systems reach operating temperature more quickly. Both these factors significantly decrease NO_x emissions, which is crucial to meet the requirements of the Euro 7 standard.

"We have seen significant interest from the automotive industry, we are currently in talks with several OEMs. A premium German manufacturer is testing the Cross Charger with a view to using the design serially in its new generation of combustion engines," says Göser. Electrified charging is also suitable for electrofuels and hydrogen applications, whether in the form of fuel cells or modified combustion engines.



Caption: The cleverly designed Cross Charger® from Swoboda is an electrified turbocharger, which can contribute to significantly lower fuel consumption and harmful gas emissions from combustion engines.

Photo: Swoboda

About Swoboda

Swoboda develops and manufactures high-precision, innovative components and systems for the automotive industry of the future. With competencies in the fields of sensors, electronics, and actuators, Swoboda contributes to automotive safety, driving comfort, and energy efficiency. For many years now, the family business has been one of the world's leading development and system partners in its sector and supplies renowned international automotive manufacturers (OEM) and suppliers (tier). Swoboda employs over 4,000 members of staff across its 12 sites around the world. Find out more at: www.swoboda.com

About G+L innotec

G+L is a technical development and engineering service provider. G+L has focused on the electrification of exhaust gas turbochargers for a number of years now. In this context, the G+L team helps companies potentially looking to adopt the technology with the development process, from the first design through to industrialization. Find out more at:

www.gl-innotec.com